

REMARKS

Applicants appreciate the indication of allowance of Claims 1-13 and of allowable subject matter in Claims 15, 17, 29 and 31. Applicants have amended Claim 15 to write Claim 15 in independent form. Applicants have also amended Claim 14 to clarify that the contact plugs contact two different contact regions of the first surface of the phase-change memory layer. Applicants have amended Claim 24 to clarify that the first and second electrodes are electrically connected to the same surface of the phase-change memory layer.

The Section 112 Rejections

Claims 18-23, 26 and 30 stand rejected under 35 U.S.C. § 112, first paragraph for failing to meet the written description requirement. Official Action, p. 2. Applicants note that these claims are all claims that were present in the original U.S. filing of this application and, therefore, are considered part of the specification of the application. Accordingly, Applicants submit that the claims meet the written description requirement for this reason alone. Applicants also submit that the claims meet the written description requirement for the additional reasons discussed below.

Turning to the specifics of the rejections, Claims 18-23 are rejected because the recitation "a second contact plug connected to the upper electrode and the first contact plug" is neither described in the specification, nor shown in the drawings. Official Action, p. 2. However, the specification clearly states:

It will be understood that although the terms first and second may be used herein to describe various regions, layers, and/or sections, these regions, layers, and/or sections should not be limited by these terms. These terms are only used to distinguish one region, layer, or section from another region, layer, or section. Thus, a first region, layer, or section discussed below could be termed a second region, layer, or section, and similarly, a second without departing from the teachings of the present invention.

Specification, p. 6, lines 28-34. Thus, the terms first, second or the like are only used as identifiers. Thus, the specification need only describe first and second contact plugs having characteristics as recited in Claims 18-23.

Claim 18 recites, in part:

a first contact plug connected to the first surface of the phase-change memory layer and configured to supply an electric signal from the lower electrode to the phase-change memory layer; and

a second contact plug connected to the upper electrode and the first contact plug.

The specification illustrates such contact plugs as the contact plug 28 and the contact plug 42 illustrated in Figures 1 and 3 and referred to in the specification as the second and third contact plugs. As seen in Figures 1 and 3 and discussed at pages 7-11 of the present specification, the contact plug 28 is connected to a first surface of the phase-change memory layer 32 and is configured to supply an electrical signal from the lower electrode 24. Thus, the contact plug 28 is a first contact plug as recited in Claim 18. The contact plug 42 is connected to the upper electrode 42 and to the contact plug 28 by the lower electrode 24. Thus, the contact plug 42 provides the second contact plug as recited in Claim 18. Accordingly, Applicants submit that the second contact plug as recited in Claims 18-23 is both described in the specification and shown in the drawings and, therefore, Claims 18-23 satisfy the written description requirement for at least these additional reasons.

With regard to Claim 26, the Official Action asserts that "[n]either the specification, nor the drawings, describe a configuration in which the first surface of the phase-change layer, wherein the first electrode is electrically connected, is opposite the substrate from the second surface of the phase-change memory layer." Official Action, p. 2. Applicants respectfully disagree. In particular, such a configuration is described in the specification, for example, at page 12, which states:

While embodiments of the present invention have been illustrated with respect to the connections to the phase-change memory layer 32 being provided on a surface to the phase-change memory layer that is adjacent the substrate 10, the connections to the phase-change memory layer could, alternatively, be provided on a surface of the phase-change memory layer 32 that is opposite the substrate.

Specification, p. 12, lines 7-11 (emphasis added). Accordingly, Applicants submit that the configuration recited in Claim 26 is described in the specification and, therefore, Claim 26 satisfies the written description requirement for at least these additional reasons.

With regard to Claim 30, the Official Action asserts that "[n]either the specification, nor the drawings, describe a configuration in which the first and second electrodes are at a same level with respect to the substrate." Official Action, p. 2. Claim 30 depends from Claim 24 that recites, in part:

a first electrode on the semiconductor substrate that is electrically connected to the first surface of the phase-change memory layer in a first contact region of the phase-change memory layer; and

a second electrode on the semiconductor substrate that is electrically connected to the phase-change memory layer in a second contact region of the phase-change memory layer, the second contact region being space apart from the first contact region.

Thus, the first electrode corresponds to one of the electrodes 22 and 24 in Figures 1 and 2 of the present application and the second electrode corresponds to the other of the electrodes 22 and 24 in Figures 1 and 2. As is clear from Figures 1 and 2, the electrodes 22 and 24 are at the same level with respect to the substrate 10. These electrodes or conductive layers, as these terms are used interchangeably in the present application, are identified in the Detailed Description as the first and third conductive layers. However, the reference to first and third conductive layers are merely identifiers to distinguish the conductive layers from each other and are not limiting recitations. Thus, the two electrodes 22 and 24 illustrated in Figures 1 and 2 provide a first electrode and a second electrode as recited in Claim 30. Accordingly, Applicants submit that the configuration recited in Claim 30 is described in the specification and, therefore, Claim 30 satisfies the written description requirement for at least these additional reasons.

The Anticipation Rejection

Claims 14 and 16 stand rejected as anticipated under 35 U.S.C. § 102(e) as being anticipated by United States Patent Publication No. 2003/0209756 to Horii (hereinafter "Horii").

Claim 14 of the present application recites:

14. (Currently Amended) A phase-change memory device comprising:

a phase-change memory layer having a first surface facing a semiconductor substrate and a second surface which is opposite the first surface;

a plurality of conductive layers between the semiconductor substrate and the phase-change memory layer;

a plurality of contact plugs connected to at least two different contact regions of the first surface of the phase-change memory layer such that the phase-change memory layer is electrically connected to ones of the plurality of conductive layers; and

an insulating layer, which covers the second surface of the phase-change memory layer.

Applicants submit that the device of Horii does not have contact plugs connected to at least two different contact regions of the surface of the phase-change memory layer that faces the substrate. Accordingly, Applicants submit that Claim 14 is not anticipated by the cited portions of Horii. Applicants submit that Claim 16 is patentable at least as depending from a patentable base claim.

Claims 24, 25, 27 and 28 stand rejected as anticipated under 35 U.S.C. § 102(e) as being anticipated by United States Patent Publication No. 2004/0000678 to Fricke (hereinafter "Fricke"). Official Action, p. 3. In particular, the Official Action cites to reference number 23 and paragraph 32 of Fricke as disclosing a phase-change memory layer and the reference numbers 39 and 33 of Figure 3 of Fricke as disclosing the first and second electrodes.

Applicants have amended Claim 24 to clarify that the first and second electrodes are electrically connected to the same surface of the phase-change memory layer. Claim 24 recites:

24. (Currently Amended) A phase change memory device comprising:

a phase-change memory layer on a semiconductor substrate, the phase-change memory layer having a major axis that is substantially parallel to a major axis of the semiconductor substrate and having a first surface and a second surface opposite the first surface that are substantially parallel to the major axis of the phase-change memory layer;

a first electrode on the semiconductor substrate that is electrically connected to the first surface of the phase-change memory layer in a first contact region of the phase-change memory layer; and

a second electrode on the semiconductor substrate that is electrically connected to the first surface of the phase-change memory layer in a second contact region of the phase-change memory layer, the second contact region being space apart from the first contact region.

Applicants submit that Fricke does not disclose or suggest the recitations of Claim 24. For example, conductors 33 and 39 do not appear to contact the same surface of the memory element 23 in the cited Figure 3. Thus, the conductors 33 and 39 do not disclose that they are both electrically connected to the same surface of a phase-change memory layer as is recited in Claim 24. Accordingly, Applicants submit that Claim 24 and the claims that depend from Claim 24 are neither disclosed nor suggested by the cited portions Fricke.

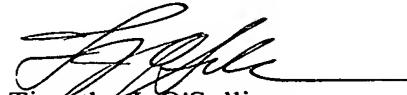
Applicants submit that Claims 25, 27 and 28 are patentable at least as depending from a patentable base claim.

Conclusion

In light of the above discussion, Applicants submit the present application is in condition for allowance, which action is respectfully requested.

It is not believed that any fee is associated with the present response other than those provided for in any accompanying documents. However, the Commissioner is hereby authorized to charge any additional fee that may be required or credit any refund to our Deposit Account No. 50-0220.

Respectfully submitted,



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